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A CLASSIFICATION OF THE CONULARIDA

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ABSTRACT

The seventeen genera of the Conulariidae are grouped into three new subfamilies. Six new genera and two new species are described.

INTRODUCTION

Although more than two hundred species of *Conularia* have been described, ranging in age from Tremadocian to Triassic, until 1939 no attempt was made to express their mutual relationships in terms of subfamily groupings. In that year Bouček (1939, p. A120 et seq.) formalized a classification that he had previously proposed (1928) for his Bohemian material. An emendation of this classification has more recently been published by Sugiyama (1942, p. 397).

In the course of a monographic study of the group I have become convinced that these attempts at classification, based mainly on surface ornamentation and the structure of the midline of the face of the shell, are inadequate to express our knowledge of the diverse forms that are found. Publication of the morphological detail on which my opinion rests must await the appearance of the monograph, but it is desirable now to set out some of my taxonomic conclusions, so that they may be used in the forthcoming *Treatise on Invertebrate Paleontology*. In brief, I find the most diagnostic features of the conularid shell to be the corner of the pyramid, and the nature of the structures found there. The character of the midline of the faces is of secondary importance, and the surface ornamentation is of very minor use, although to some extent it is correlated with more important features.

The scheme published by Bouček in Schindewolf's *Handbuch der Paläozoologie* is readily available, and it will be sufficient to summarize the classification given there without comment. The "Gruppen" refer to Bouček's informal classification of 1928.

CLASSIFICATION ACCORDING TO BOUČEK

Order? Conularida Miller and Gurley 1896
- Family Conularidae (*sic*) Walcott 1886
  - Genus *Conularia* Miller (*sic*) 1818
    - Subgenus *Archaeoconularia* Bouček 1939 (Gruppen der *Conularia fecunda* und *insignis*)
    - Subgenus *Mesoconularia* Bouček 1939 (Gruppe der *Conularia fragilis*)
    - Subgenus *Conularia* Miller
    - Subgenus *Plectoconularia* Bouček 1939 (Gruppe der *Conularia proteica*)
  - Genus *Metaconularia* Foerste 1928 (Gruppen der *C. exquisita* und *solitaria*)
  - Genus *Pseudoconularia* Bouček 1939 (Gruppe der *Conularia grandissima*)
- Family Conulariellidae Kiderlen 1937
  - Genus *Conulariella* Bouček 1928
- Family Serpulitidae Bouček 1939
  - Genus *Serpulites* Murchison 1839

As I pointed out in 1940 (Sinclair, 1940, p. 73), this treatment of *Conularia* s. str. is based on a misinterpretation of the genotype. Bouček's *Plectoconularia* is *Conularia* s. str., and his *Conularia* s. str. is *Paraconularia*.

CLASSIFICATION ACCORDING TO SUGIYAMA

Family I. Conularidae (*sic*) Walcott 1886
- Genus 1. *Conularia* Miller (*sic*) 1821
  - Subgenus 1. *Archaeoconularia* Bouček 1939
  - Subgenus 2. *Mesoconularia* Bouček 1939
  - Subgenus 3. *Conularia* (s. str.) Miller
  - Subgenus 4. *Paraconularia* Sinclair 1940
  - Subgenus 5. *Plectoconularia* Bouček 1939
- Genus 2. *Metaconularia* Foerste 1928
- Genus 3. *Pseudoconularia* Bouček 1939

Family II. Conulariellidae Kiderlen 1937, emend.
- Genus 4. *Conulariella* Bouček 1928
- Genus 5. *Conchopeltis* Walcott 1875
- Genus 6. *Neoconularia* Sugiyama 1942

Family III. Conulariopsisdae (*sic*) Sugiyama 1942
- Genus 7. *Conulariopsis* Sugiyama 1942

Family IV. *Serpulitidae* Bouček 1939
- Genus 8. *Serpulites* Murchison 1839

Sugiyama's paper is not generally available in the United States, so some comments may be in order. I am greatly indebted to Mr. C. G. Robertson of Tokyo for his kindness in providing me with a photostat of the paper.

The inclusion of both *Paraconularia* and *Plectoconularia* as subgenera of *Conularia* must have been based on a misreading of

my paper (1940a). The type species of *Conularia* must belong to one or the other of these groups, but not both.

Conchopeltis (Knight, 1937, p. 186) may be a conularid, but it has nothing in common with *Conulariella*, its broad spreading shell contrasting strikingly with the thin lamellar shape of the latter genus. I do not know where to put it, but *Conchopeltis* does not belong in the Conulariellidae.

Neoconularia is a new genus (Sugiyama gives the date as 1941, but this is an error) based on *Conularia rectangularis* Hayasaka 1920. Unfortunately, this species is known only from steinkerns, and none of the descriptions (Hayasaka, 1920, p. 87; 1924, p. 111; Sugiyama, 1942, p. 391) give details of the nature of the corner of the shell, or of the facial ornament. One may say from the descriptions that the species has nothing in common with *Conulariella*, but its correct position cannot be stated with certainty. I place it in the Paraconulariinae mainly because that subfamily is better represented in the Upper Paleozoic than the others. It will not be possible to refer other species to this genus until more information on the type species is available.

Sugiyama's *Conulariopsis* (for which he gives the date 1938, although this refers only to an oral presentation of the description to a meeting of the Palaeontological Society of Japan) is based on a new species, *Conulariopsis quadrata*, from the Lower Triassic. It is characterized by a lack of corner grooves, the corners of the pyramid being raised; by coarse sinuous longitudinal ridges that apparently corrugate the surface of the shell; and by a very irregular series of widely spaced transverse folds that appear in the photograph as if they could be adventitious. *Conulariopsis* is possibly a conularid, but it should be placed in a separate family.

PROPOSED CLASSIFICATION

Order ?Conularida Miller and Gurley 1896

?Family Conulariopsidae Sugiyama 1942

Family Conulariellidae Bouček 1939

Genus *Conulariella* Bouček 1928

Family Conulariidae Walcott 1886

Subfamily Conulariinae, subfam. nov. Conularids with the corners of the shell simply inflected, not interrupting the surface ornamentation, and with no strengthening rods or other structures.

Genus *Conularia* Sowerby 1820. Type, *Conularia quadrisulcata* Sowerby 1820.

Genus *Mesoconularia* Bouček 1939. Type, *Conularia fragilis* Barrande 1867 (see Bouček, 1928, p. 84).

Genus *Metaconularia* Foerste 1928. Type, *Conularia aspersa* Lindström 1884 (see Sinclair, 1940a, p. 101 et seq.).

Genus *Pseudoconularia* Bouček 1939. Type, *Conularia grandissima* Barrande 1867 (see Sinclair, 1941, p. 125 et seq.).

Genus *Archaeoconularia* Bouček 1939. Type, *Conularia insignis* Barrande 1867 (see Sinclair, 1944, p. 87 et seq.).

Genus *Palaenigma* Walcott 1886. Type, *Tetradium wrangeli* Schmidt 1874 (see Schmidt, 1874, p. 42 et seq.; Sinclair, 1944, p. 87).

Genus *Diconularia* gen. nov. Type, *Conularia micronema* Meek 1871.

Genus *Exoconularia* gen. nov. Type, *Conularia exquisita* Barrande 1867.

Genus *Anaconularia* gen. nov. Type, *Conularia anomala* Barrande 1867.

Subfamily Paraconulariinae, subfam. nov. Conularids with the corners of the shell sharply inflected; the ornamentation interrupted there, the transverse elements either stopping or alternating.

Genus *Paraconularia* Sinclair 1940. Type, *Conularia inaequicostata* de Koninck 1883.

Genus *Calloconularia* gen. nov. Type, *Calloconularia strimplei*, sp. nov.

Genus *Eoconularia* Sinclair 1944. Type, *Conularia loculata* Wiman 1894 (see Sinclair, 1944, p. 90).

Genus *?Neoconularia* Sugiyama 1942. Type, *Conularia rectangularis* Hayasaka 1920.

Subfamily Ctenoconulariinae, subfam. nov. Conularids with the corners of the shell strengthened with internal carinae or other types of thickening.

Genus *Ctenoconularia* gen. nov. Type, *Ctenoconularia obex*, sp. nov.

Genus *Climacoconus* Sinclair 1942. Type, *Conularia quadrata* Walcott 1879 (see Sinclair, 1942, p. 226).

Genus *Glyptoconularia* gen. nov. Type, *Conularia gracilis* Hall 1847.

Genus *Conularina* Sinclair 1942. Type, *Conularia triangulata* Raymond 1905 (see Sinclair, 1942, p. 226).

DESCRIPTIONS OF GENERA AND SPECIES

Conulariinae, subfam. nov.

Diconularia, gen. nov.

Conularia auctt. (in part).

Mesoconularia Bouček and others (in part).

Type species.—*Conularia micronema* Meek 1871 (see Meek, 1875, p. 316).

Diagnosis.—Conulariinae with closely appressed transverse ridges on the faces, set with prominent subcircular pustules; the corners of the shell simple, the midline of the faces unmarked on the surface, but with a tendency to be raised on the inner side.

Remarks.—In 1940 I followed Bouček in taking *Mesoconularia* to be an inclusive genus, with rather wide limits. I now feel that this is unwise, and I restrict *Mesoconularia* to the few forms that closely resemble the type species, *M. fragilis*. There are, especially in the Upper Paleozoic, a number of species forming a group that has rather obviously developed from *Conularia*, species of that genus

often showing as gerontic characters the crowding of the transverse ridges and accentuation of the pustules that are normal in *Diconularia*. In view of this, it seems probable that *Diconularia* arose several times, and should be considered a form-genus until the relationships of the species can be worked out more thoroughly.

The genus ranges from the Middle Ordovician to the Pennsylvanian.

Exoconularia, gen. nov.

Conularia auctt. (in part).

Metaconularia Bouček and others (in part).

Type species.—*Conularia exquisita* Barrande 1867 (see Bouček, 1928, p. 70).

Diagnosis.—Conulariinae with accessory longitudinal lines along the faces, varying in position in different species; the surface ornamented with transverse rows of discrete pustules.

Remarks.—This is the group of species that I left as "*Metaconularia?*" in 1940. The relationships are still not as clear as I would like to see them, but these species are clearly separable from *Metaconularia* s. str., with its pair of strong internal carinae at the midline, and I place them in this new genus. I suspect that *Exoconularia* itself needs subdivision, but I do not feel that my knowledge of the European species warrants that step at the moment.

The genus is exclusively Ordovician, occurring from the Tremadocian to the Caradocian.

Anaconularia, gen. nov.

Conularia auctt. (in part).

Metaconularia Bouček (in part).

Type species.—*Conularia anomala* Barrande 1867 (see Barrande, 1867, p. 33).

Diagnosis.—Conulariinae with no trace of a corner groove, but instead with the corner of the shell elevated into a sharp or rounded ridge.

Remarks.—The abundant specimens of this species are all steinkerns, but the lack of the corner groove is not due to that fact, since in all other conularids the presence of the groove is emphasized, rather than obscured, on the steinkern. Similarly, the apparent lack of any superficial ornamentation cannot be attributed to pres-

ervation, since in the same beds occur steinkerns of other species with the fine surface markings well impressed either on the specimen itself or on its external impression.

The only species occurs in the Middle Ordovician Drabov quartites ($d\gamma$) at Drabov and other localities in Bohemia. Barrande had over 1,500 specimens when he drew up his description of the species. Of these, the specimen figured by him (pl. 7, figs. 10 and 11) may be designated as lectotype. It is presumed to be in the National Museum in Prague.

Paraconulariinae, subfam. nov.

Calloconularia, gen. nov.

Conularia Girty (in part).

Type species.—Calloconularia strimplei, sp. nov.

Diagnosis.—Paraconulariinae with low crowded transverse ridges and, in the interspaces, longitudinal bars.

There exists in the Upper Paleozoic of the United States a group of very similar shells that should be separated from *Paraconularia.* They are always small, and the surface markings are remarkably uniform. At the shoulders of the corner groove the interspaces swell strongly, so that they continue into the groove, while the transverse ridges stop at the shoulders. This feature is also seen in some species now referred to *Paraconularia,* for example, *P. victa* (White), so that it is not diagnostic for *Calloconularia.*

I know six species in the Pennsylvanian of Oklahoma and Texas. The only described form is that named *Conularia crustula holdenvillae* by Girty in 1911 (see Girty, 1915, p. 44).

Calloconularia strimplei,[1] sp. nov. Figure 56, D–F.

Horizon and locality.—Pennsylvanian, Ochilate group, an unnamed shale 30 feet above the Torpedo sandstone. Two miles north-northeast of Capan, Oklahoma.

Types.—C.N.H.M. No. PE 142, holotype; five paratypes, No. PE 143. Harrell L. Strimple, collector. Gift of G. W. Sinclair.

Description.—Shell small, but of the usual size for the genus. Length of holotype 15 mm., greatest width of face 4 mm.; shell

[1] Named for Mr. Harrell L. Strimple, well known for his work on the Echinodermata.

not quite straight, tapering regularly or a little more rapidly apically, apical angle about 15°. Section rhombic, almost square. Faces plane or a little concave, equal; the midline indicated only by the ornamentation or by a very slight ridge apically. Corner with a rather wide, shallow groove, the bottom angulate and filled with the ends of the interspaces, the shoulders broadly but sharply rounded. Apex not known. The apertural lobes have been seen in some specimens, but show no real details. The holotype figured is complete at the apertural end, but the lobes are either lacking or strongly infolded, so that they are not seen.

Surface with rather low, but prominent, flat-topped transverse ridges, eight in a length of 1 mm. apically, seven and one-half and six in the same length measured successively nearer the aperture. The ridges are smooth. They alternate at the corners, but have no regularity of position at the midline. Their direction can be seen in the figures. The interspaces are from one to one and one-half times as wide as the ridges, and are marked by very irregular longitudinal wrinkles. They swell sharply near the corner, so that by the time they reach the shoulder of the groove they are higher than the ridges, and continue past them into the bottom of the groove, where they alternate with those from the adjacent face.

Ctenoconulariinae, subfam. nov.

Ctenoconularia, gen. nov.

Conularia auctt. (in part).

Type species.—*Ctenoconularia obex,* sp. nov.

Description.—Ctenoconulariinae with strikingly slender shells. The corner of the shell appears on the surface as a wide shallow groove, on the interior as a strongly carinate ridge. The midline of the face is marked by an interruption of the transverse ridges, but the internal structure is not known except in one species. The transverse ridges that "ornament" the faces are biconvex in section, that is, they extend past the surface both externally and internally, so that the steinkern appears grooved when the test is removed. The ridges stop at the shoulder of the corner grooves. They are pustulose, and the pustules usually continue into the next orad interspace as projections of greater or lesser length. This results at times in an appearance very similar to that of *Conularia* s. str., but in that genus the longitudinal bars that occur in the interspaces are always continuous with, or opposite, pustules on the next ridge orad, and

thus have a very different origin. Neither the apex nor the aperture has been seen in any specimen. No apical schott[1] has been seen.

Remarks.—The genus ranges from the Black River (Middle Ordovician) to the Hamilton (Middle Devonian). Sixteen species are known to me, of which *Conularia crebristria* Hall 1876 (Hall, 1879, p. 210) and *Conularia trentonensis occidentalis* Bradley (1930, p. 242) are previously described American forms.

Ctenoconularia obex,[2] sp. nov. Figure 56, A–C.

Horizon and locality.—Middle Ordovician, Sprechs Ferry member of the Platteville formation. Minneapolis, Minnesota.

Types.—University of Minnesota collections, holotype No. 6608; three paratypes Nos. 6609–6611; F. W. Sardeson, collector.

Description of holotype.—Shell rather small, 27 mm. long; face 5 mm. wide, straight, tapering regularly and very slowly, apical angle about 6°. Section square. Faces plane, equal, the midline marked only by the course of the ornamentation. Corner with a rather wide shallow groove, the shoulders broadly rounded, the bottom broadly rounded and smooth.

Surface with narrow, rather low, rounded, transverse ridges, six in a length of 2 mm. at the smaller end of the specimen, eight in the same length near the middle, and seven near the larger end; the crests marked by well-separated longitudinal elevations that extend very slightly into the next orad interspace but are somewhat longer near the corners; about ten to twelve in a width of 1 mm. The transverse ridges are almost all continuous at the midline and opposite at the corners. They are slightly curved, well arched across the face, the angle at the midline about 135°. Interspaces two to three times as wide as the ridges, smooth except for the projections mentioned above.

Remarks.—A much larger paratype, with facial width at least 11 mm., has seven transverse ridges in a length of 5 mm., set with seven longitudinal elevations in a width of 1 mm.

[1] The transverse structure sealing off the apex in many species of Conulariinae (but apparently never in Paraconulariinae or Ctenoconulariinae) has been referred to by authors as a septum, a diaphragm, or in other ways. These terms suggest an undesirable homology with structures in other animals, and I have therefore used the noncommittal German word *Schott* (plural *Schotten*) for this peculiarly conularid structure.

[2] Derivation of name: Latin *obex*, a bolt.

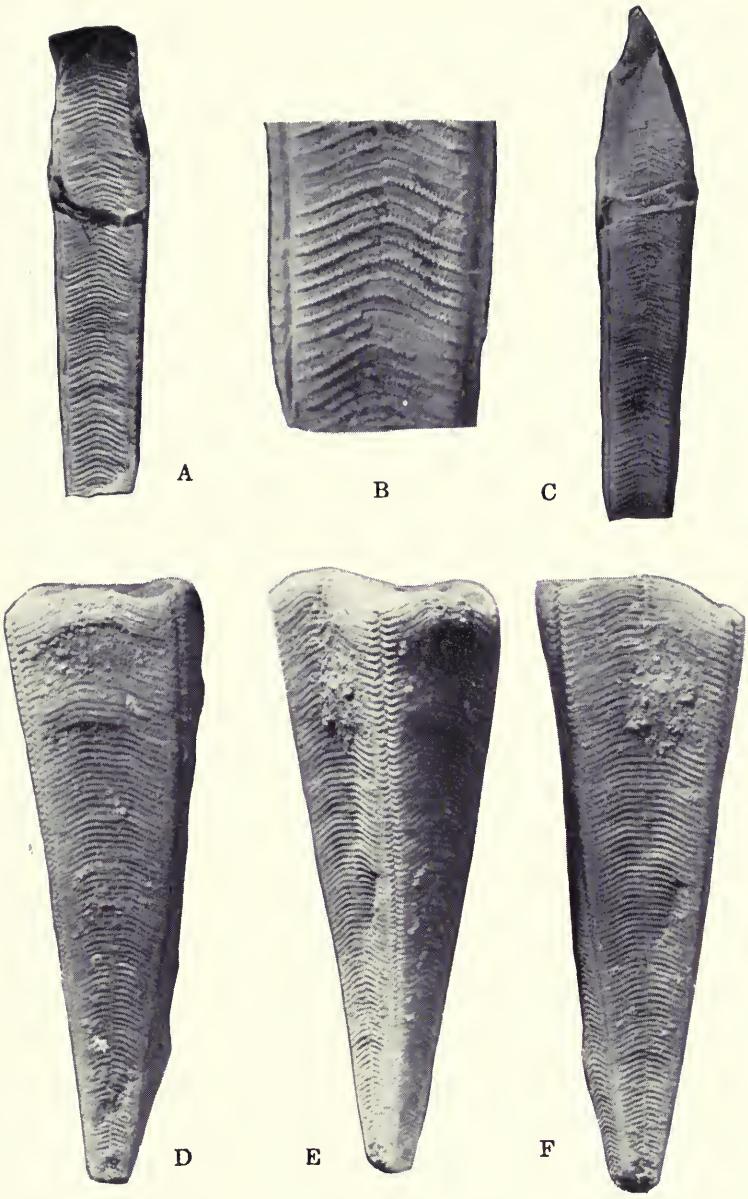

FIG. 56. A–C. *Ctenoconularia obex*, sp. nov. Holotype; ×2½ and ×7. Univ. Minnesota coll. No. 6608. Ordovician, Sprechs Ferry member of Platteville, Minneapolis, Minnesota. D–F. *Calloconularia strimplei*, sp. nov. Holotype; ×5. C.N.H.M. PE 142. Pennsylvanian, Ochilate group, Capan, Oklahoma.

Glyptoconularia, gen. nov.

Conularia auctt. (in part).

Genotype.—*Conularia gracilis* Hall 1847 (see Hall, 1847, p. 224).

Description.—Ctenoconulariinae with strong corner strengthenings, a pronounced mesial carina on the interior at the midline of the face, and strong longitudinal surface ornamentation.

Remarks.—I find it difficult to determine what weight to give the unique surface ornamentation of *Conularia gracilis.* But for the surface, this species might be referred to *Eoconularia.* At the moment it seems simplest to erect a monotypic genus.

It should be noted that the young "*Conularia gracilis*" described by Ruedemann (1896, 1898) and copied by so many textbooks, is not a conularid. It belongs to the genus *Tubelelloides,* which Howell has recently erected (1949, p. 4) for the worm-tubes long known as *Serpulites* (see Ruedemann, 1916, p. 85).

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